Interest Rates and Bond Valuation

Chapter 7

Outline

1. Introduction to Bonds and Bond Valuation
2. Bond Features and Definitions
3. Bond Markets, Inflation, and Interest Rates

Introduction to Bonds and Bond Valuation

Bonds

A debt instrument issued by corporations or governments to borrow money for investments.

Generally an *interest-only* loan, with regular interest payments (called coupons) and the principal payment at the end.

An Example of A Corporate Bond

The CFO of Coca-Cola would like to raise $1,000,000 in debt financing to be repaid in 10 years. They will borrow at a rate of 8%. They'll sell 1,000 total bonds, so that each has a face value of $1,000.

An Example of A Corporate Bond

Year	0	1	2	3	4	5	6	7	8	9	10
Coupon		$80	$80	$80	$80	$80	$80	$80	$80	$80	$80
Face Value											$1,000
Payment		$80	$80	$80	$80	$80	$80	$80	$80	$80	$1,080

Coupon: 8% x $1,000 = $80 paid to the bond holder each year, where 8% is the *coupon rate*

Face Value, Principal, or Par = $1000, or the amount borrowed and paid back in the final year for each bond.

How Much Would You Pay for the Bond?

We can determine the value of the bond by combining:

1. The Present Value of the Coupons
2. The Present Value of the Principal

$$Bond\ Value = [C \times \frac{1 - \frac{1}{(1+r)^t}}{r}] + \frac{FV}{(1+r)^t}$$

But what is the discount rate? The coupon rate stays the same, but the interest rates in the market change.

Yield to Maturity

The YTM is the rate required in the market on a bond, also called the *yield.*

The coupon rate is often different from the yield. When the value = principal, however, the coupon rate equals the yield.

The YTM can be thought of as the EAR.

An Example of A Corporate Bond

What is the value of this bond *today* given that the prevailing interest rate in the market is 8%?

Year	0	1	2	3	4	5	6	7	8	9	10
Coupon		$80	$80	$80	$80	$80	$80	$80	$80	$80	$80
Face Value											$1,000
Payment		$80	$80	$80	$80	$80	$80	$80	$80	$80	$1,080

PV of the Coupons:

N = 10, PMT = 80, I/Y = YTM = 8, CPT PV = -536.81

PV of the Face Value:

N = 10, FV = 1000, I/Y = YTM = 8, CPT PV = -463.19

Value of the Bond:

536.81 + 463.19 = $1,000 or N=10, FV =1000, I/Y=YTM=8, PMT=80, CPT PV = -$1,000

An Example of A Corporate Bond

Now assume one year has passed. Investors now demand a 10% yield for Coca-Cola bonds. What is the value of the bond now?

Year	0	1	2	3	4	5	6	7	8	9	10
Coupon		$80	$80	$80	$80	$80	$80	$80	$80	$80	$80
Face Value											$1,000
Payment		$80	$80	$80	$80	$80	$80	$80	$80	$80	$1,080

PV of the Coupons:

N = 9, PMT = 80, I/Y = YTM = 10, CPT PV = -460.72

PV of the Face Value:

N = 9, FV = 1000, I/Y = YTM = 10, CPT PV = -424.10

Value of the Bond:

460.72 + 424.10 = $884.82 or N=9, PMT=80, FV=1000, I/Y=YTM=10, CPT PV = -$884.82

Premium and Discount Bonds

Discount Bonds sell for less than face value, or

D: Price < Par
and
D: Coupon % < YTM %

Premium Bonds sell for more than face value, or

P: Price > Par
and
P: Coupon % > YTM %

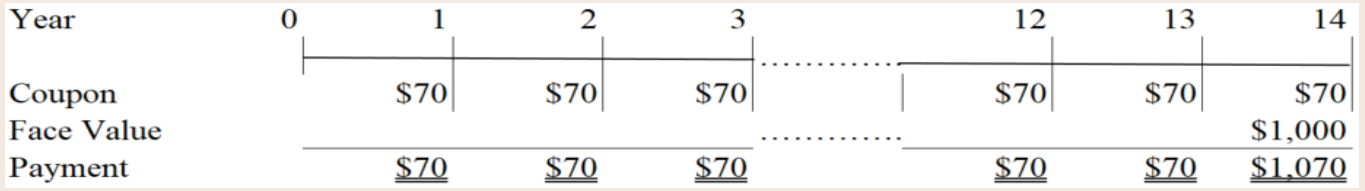
Semiannual Coupons

In practice, coupons are paid twice a year.

Pepsi raised $1,000,000 in debt financing, and 7 years are left on this debt issue. The YTM on these bond are 16% and the coupon rate is 14%. 1,000 bonds were sold, so that each has a face value of $1,000. Payments are made semiannually. What is the value today for these bonds?

Semiannual Coupons

The coupon rate is like an APR- a bond holder will receive 14%/2 = 7% (or $1000 x 0.07 = $70) each period. There are 2 x 7 = 14 periods. The discount rate is the YTM/2 = 16%/2 = 8%



PV of the Coupons
N = 14, PMT = 70, I/Y = 8, CPT PV = -577.10

PV of the Face Value
N = 14, FV = 1000, I/Y =8, CPT PV = -340.46

Value of the Bond
577.10 + 340.46 = $917.56

Price and Yields

Bond price and yield (or interest rates) always move in *opposite* directions.

As YTM increases, bond price falls.
As YTM decreases, bond price rises.

Finding a Bond Yield

To find a bond yield given the other characteristics of the bond, we have to rely on trial and error.

Finding a Bond Yield

Example: Suppose you are quoted $955.14 for a 6 year, 8% annual coupon bond. To determine the YTM, plug in C = 80, t=6, FV = 1000, and Bond Value= 955.14 into the equation below. Then plug in guesses for r until both sides equate.

$$Bond\ Value = [C \times \frac{1 - \frac{1}{(1+r)^t}}{r}] + \frac{FV}{(1+r)^t}$$

Because this is a discount bond, your guess should start above 8%. This one is just under 9%).

You can also use the yield on similar bonds as a starting point.

Current Yield

The annual coupon divided by the current bond price. This is the effective rate of interest for a bond at its current price. This is the actual income rate of return as opposed to the coupon rate or YTM.

$$Current\ Yield = \frac{Annual\ Coupon}{Bond\ Price}$$

Current Yield Example

Assume you buy that Coca-Cola bond for $955.14. The coupons are $80. What is the income rate of return (that is, what is the coupon relative to the bond price)?

Current Yield = 80/955.14 = 8.38%

Notice that the current yield doesn't take into account if the bond is selling at a discount or premium.

To Summarize

Bonds are debt instruments. We value bonds by using present value techniques, discounting at the YTM.

Bond Features and Definitions

Review of Securities

Corporations issue both *equity* and *debt* securities

> **Equity**: represent ownership interest with a residual claim
> **Debt**: represent something that must be repaid

These are stock (equity) and bonds (debt).

Corporations issuing bonds are borrowing and are called **DEBTORS**. Those that hold the bond and are getting repaid are **CREDITORS** or lenders.

Example of Securities

TJX Companies (TJX): TJ Maxx, HomeGoods, Marshalls

Visit finra-markets.morningstar.com to see at what price the *equity* shares are trading and to explore the *debt* offerings (the bonds).

Debt vs. Equity

1. Debt is not ownership interest in the firm. Creditors only get back money according to the terms of the lending agreement.
2. Interest payments are tax deductible (unlike dividends) because it is a cost of doing business.
3. Unpaid debt is a liability to the firm. Equity is not a liability and unpaid dividends do not need to be paid.

Debt vs. Equity Example

Let's look at TJX's income statement and balance sheet.

1. Where is the interest expense on the income statement? The dividends?
2. Where is debt on the balance sheet?

Debt vs. Equity Example

The TJX Companies, Inc.

CONSOLIDATED STATEMENTS OF INCOME

Amounts in thousands except per share amounts	Fiscal Year Ended February 3, 2018 (53 weeks)	January 28, 2017	January 30, 2016
Net sales	**$35,864,664**	$33,183,744	$30,944,938
Cost of sales, including buying and occupancy costs	**25,502,167**	23,565,754	22,034,523
Selling, general and administrative expenses	**6,375,071**	5,768,467	5,205,715
Impairment of goodwill and other long-lived assets, related to Sierra Trading Post ("STP")	**99,250**	—	—
Loss on early extinguishment of debt	**—**	51,773	—
Pension settlement charge	**—**	31,173	—
Interest expense, net	**31,588**	43,534	46,400
Income before provision for income taxes	**3,856,588**	3,723,043	3,658,300
Provision for income taxes	**1,248,640**	1,424,809	1,380,642
Net income	**$ 2,607,948**	$ 2,298,234	$ 2,277,658
Basic earnings per share:			
Net income	**$ 4.10**	$ 3.51	$ 3.38
Weighted average common shares – basic	**636,827**	655,647	673,484
Diluted earnings per share:			
Net income	**$ 4.04**	$ 3.46	$ 3.33
Weighted average common shares – diluted	**646,105**	664,432	683,251
Cash dividends declared per share	**$ 1.25**	$ 1.04	$ 0.84

Debt vs. Equity Example

The TJX Companies, Inc.

CONSOLIDATED BALANCE SHEETS

Amounts in thousands except share amounts	Fiscal Year Ended February 3, 2018	January 28, 2017
ASSETS		
Current assets:		
Cash and cash equivalents	**$ 2,758,477**	$ 2,929,849
Short-term investments	**506,165**	543,242
Accounts receivable, net	**327,166**	258,831
Merchandise inventories	**4,187,243**	3,644,959
Prepaid expenses and other current assets	**706,676**	373,893
Total current assets	**8,485,727**	7,750,774
Net property at cost	**5,006,053**	4,532,894
Non-current deferred income taxes, net	**6,558**	6,193
Goodwill	**100,069**	195,871
Other assets	**459,608**	398,076
TOTAL ASSETS	**$ 14,058,015**	$ 12,883,808
LIABILITIES		
Current liabilities:		
Accounts payable	**$ 2,488,373**	$ 2,230,904
Accrued expenses and other current liabilities	**2,522,961**	2,320,464
Federal, state and foreign income taxes payable	**114,203**	206,288
Total current liabilities	**5,125,537**	4,757,656
Other long-term liabilities	**1,320,505**	1,073,954
Non-current deferred income taxes, net	**233,057**	314,000
Long-term debt	**2,230,607**	2,227,599
Commitments and contingencies (See Note L and Note N)		
SHAREHOLDERS' EQUITY		
Preferred stock, authorized 5,000,000 shares, par value $1, no shares issued	**—**	—
Common stock, authorized 1,200,000,000 shares, par value $1, issued and outstanding 628,009,022 and 646,319,046, respectively	**628,009**	646,319
Additional paid-in capital	**—**	—
Accumulated other comprehensive income (loss)	**(441,859)**	(694,226)
Retained earnings	**4,962,159**	4,558,506
Total shareholders' equity	**5,148,309**	4,510,599
TOTAL LIABILITIES AND SHAREHOLDERS' EQUITY	**$ 14,058,015**	$ 12,883,808

Long-Term Debt

Debt securities with maturities greater than one year.

Typically, debt with maturities less than 10 years are called **NOTES** while debt with maturities longer than 10 years are called **BONDS**.

Long term debt can be **PRIVATELY PLACED** (not offered to the public) and **PUBLIC-ISSUED** (offered to the public).

The Indenture

The written agreement between the corporation and the lender that details the terms.

A legal document that includes:

- General terms of the bond
- The amount issued
- Description of property used as collateral (what the lenders get if the borrowers default- your house if you have a mortgage!)
- Repayment arrangements

General Terms of the Bond

Registered (payment made to the registered holder) or **Bearer** (payment made to the holder-can be easily stolen).

Debenture (unsecured debt with a claim only on property not pledged elsewhere) or **Collateralized** (backed by property).

Seniority (if you hold *subordinated* debt, the *senior* debt gets paid back first in the event of a default)

Sinking Funds (a fund established by the borrower with the **trustee**, a bank or intermediary that handles the account, to retire debt that it doesn't need to issue)

General Terms of the Bond Cont.

Call Provisions: allow the borrower to pay a set price for a bond, often higher than the face value, the call premium, in order to recall your bond and no longer make payments.

Protective Covenants: rules for borrower, such as limiting dividends, maintaining a certain level of working capital, restrictions for issuance of more debt, etc.

Bond Ratings

Moody's, Fitch, and Standard & Poor's (S&P) rate bonds based on their probability of default.

Lenders generally require that bonds with low ratings pay higher yields.

Investment grade bonds are higher quality than **Speculative grade (junk) bonds**

Moody's		S&P		Fitch		Rating description	
Long-term	Short-term	Long-term	Short-term	Long-term	Short-term		
Aaa	P-1	AAA	A-1+	AAA	F1+	Prime	Investment-grade
Aa1		AA+		AA+		High grade	
Aa2		AA		AA			
Aa3		AA−		AA−			
A1		A+	A-1	A+	F1	Upper medium grade	
A2		A		A			
A3	P-2	A−	A-2	A−	F2		
Baa1		BBB+		BBB+		Lower medium grade	
Baa2	P-3	BBB	A-3	BBB	F3		
Baa3		BBB−		BBB−			
Ba1	Not prime	BB+	B	BB+	B	Non-investment grade speculative	Non-investment grade AKA high-yield bonds AKA junk bonds
Ba2		BB		BB			
Ba3		BB−		BB−			
B1		B+		B+		Highly speculative	
B2		B		B			
B3		B−		B−			
Caa1		CCC+	C	CCC	C	Substantial risks	
Caa2		CCC				Extremely speculative	
Caa3		CCC−				Default imminent with little prospect for recovery	
Ca		CC					
		C					
C		D	/	DDD	/	In default	
/				DD			
				D			

US Government Bonds

Issued by the US government, the largest borrower in the world.

Treasury Bills (called **T-Bills**) have a maturity of less than a year.

Treasury Notes have maturities between 1 and 10 years.

Treasury Bonds have maturities greater than 10 years.

Assumed that there is no default risk- they print money.

Municipal Bonds

Issued by state and local governments, but *can* default.

The coupon payments made to lenders are exempt from federal income taxes, making it an attractive investment for high-tax bracket investors.

Zero Coupon Bonds

Don't make coupon payments: simply sell for a discount and are paid back in full at the maturity.

You still pay taxes as if you were receiving coupons.

To Summarize

Bonds are debt securities. The bond holder is the lender. The indenture provides terms and provisions for the bond. Rating agencies evaluate default risk. The federal and local governments also borrow money through bonds.

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Bond Markets, Inflation, and Interest Rates

Bond Markets

Bonds are traded *over the counter* (OTC), meaning that *dealers* buy and sell bonds from various parties.

Bid- the price the dealer will pay you for a bond

Ask- the price at which the dealer will sell you a bond

Bid-Ask Spread- the positive difference between the bid and ask prices

U.S. Treasury Quotes

U.S. Treasury Quotes

TREASURY NOTES & BONDS

GO TO: Bills

Monday, June 11, 2018 Find Historical Data | WHAT'S THIS?

Treasury note and bond data are representative over-the-counter quotations as of 3pm Eastern time. For notes and bonds callable prior to maturity, yields are computed to the earliest call date for issues quoted above par and to the maturity date for issues below par.

Maturity	Coupon	Bid	Asked	Chg	Asked yield
11/15/2020	1.750	97.9922	98.0078	-0.0938	2.603
11/15/2020	2.625	100.0078	100.0234	-0.1016	2.615
11/30/2020	1.625	97.6328	97.6484	-0.0859	2.615
11/30/2020	2.000	98.5391	98.5547	-0.0703	2.609
12/15/2020	1.875	98.2188	98.2344	-0.0703	2.607
12/31/2020	1.750	97.8594	97.8750	-0.0703	2.617
12/31/2020	2.375	99.3828	99.3984	-0.0781	2.620
1/15/2021	2.000	98.4297	98.4453	-0.0703	2.624
1/31/2021	1.375	96.8047	96.8203	-0.0859	2.631

http://www.wsj.com/mdc/public/page/2_3020-treasury.html

Looking at the first row:

Maturity = 11/15/2020

Coupon Rate = 1.750%, but semiannual payments of 1.750/2 = 0.875%

Bid = the dealer will pay you is 97.99% of par

Asked = you'll have to pay the dealer 98.0078% of par to purchase

Chg = this bond's ask price fell 0.0938% from yesterday

Asked yield = the YTM based on Asked price

Real and Nominal Interest Rates

Nominal Interest rates have not been adjusted for inflation.

Real Interest rate *have* been adjusted for inflation.

Real and Nominal Rates Example

You are throwing a Super Bowl party in exactly one year. You plan on buying several Little Caesar's Hot -N- Ready Pizzas for $5 each. You put exactly $100 in an investment today that returns 15.5% annually.

How many pizzas can you afford for the Super Bowl? Assume an inflation rate of 5%.

If we purchased pizzas today, it would be 20 pizzas.
Investment growth: $100 x 1.155 = $115.50
Pizza price: $5 x 1.05 = $5.25
Pizza purchase: $115.50 / $5.25 = 22 pizzas

We could have bought 23 pizzas if no inflation.

Real and Nominal Rates Example

So, even though our investment grew at 15.5%, our purchasing power only grew by:

$$\frac{22\ pizzas - 20\ pizzas}{20\ pizzas} = 10\%$$

Thus, the **REAL RATE** of return on my investment is 10%, whereas the **NOMINAL RATE** is 15.5%.

Put another way:
The **NOMINAL RATE** on an investment is the % change in dollars you have.
The **REAL RATE** on an investment is the % change in how much you can buy.

Real and Nominal Rates Example

To determine the purchasing power of our investment, we can *deflate* our future investment value by dividing it by (1 + Inflation):

$$\$115.50 / 1.05 = \mathbf{\$110}$$

This means our purchasing power in one year will actually be **$110** in today's dollar terms.

$$\$110 \text{ in today's terms} / \$5 \text{ cost in today's terms} = 22 \text{ pizzas}$$

The Fisher Effect

Named after the economist Irving Fisher, a relationship between nominal rates (R), real rates (r), and the inflation rate (h).

$$1 + R = (1 + r) \times (1 + h)$$

$$R \approx r + h$$

The Fisher Effect Example

You want to withdraw $25,000 of *purchasing power* each year for the next 3 years to finance your child's college tuition. How much do you need to invest today in an account earning 10% to be able to do this? Assume inflation of 4% per year.

1. We can discount *nominal* cash flows at the *nominal* rate.
2. We can discount *real* cash flows at the *real* rate.
3. (1) and (2) above will be equal.

(1) Nominal Cash Flows at the Nominal Rate

We want $25,000 in purchasing power, so the nominal withdrawals should be:

$$C_1 = \$25{,}000 \times 1.04^1 = \$26{,}000$$
$$C_2 = \$25{,}000 \times 1.04^2 = \$27{,}040$$
$$C_3 = \$25{,}000 \times 1.04^3 = \$28{,}121.60$$

And the PV at the nominal rate of 10% is:

$$PV = 26000/1.10^1 + 27040/1.10^2 + 28121.60/1.10^3 = \$67{,}112$$

(2) Real Cash Flows at the Real Rate

First find the real rate:

$$1 + R = (1 + r) \times (1 + h)$$
$$1 + 0.10 = (1 + r)(1 + 0.04)$$
$$r = 0.0577$$

Now, find the PV at this rate.

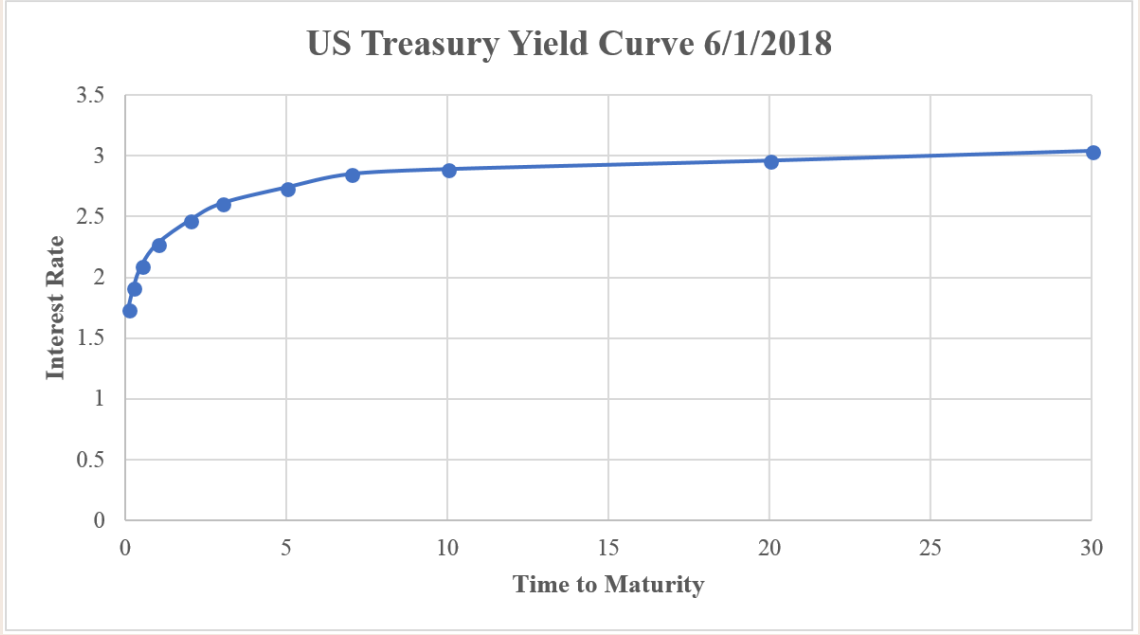
N = 3, I/Y =5.76923, PMT = 25000, CPT PV = $67,112

As expected, the two methods yield the same result.

The Term Structure of Interest Rates

The relationship between interest rates and time to maturities.

Date	1 Mo	3 Mo	6 Mo	1 Yr	2 Yr	3 Yr	5 Yr	7 Yr	10 Yr	20 Yr	30 Yr
6/1/2018	1.74	1.92	2.1	2.28	2.47	2.61	2.74	2.85	2.89	2.96	3.04



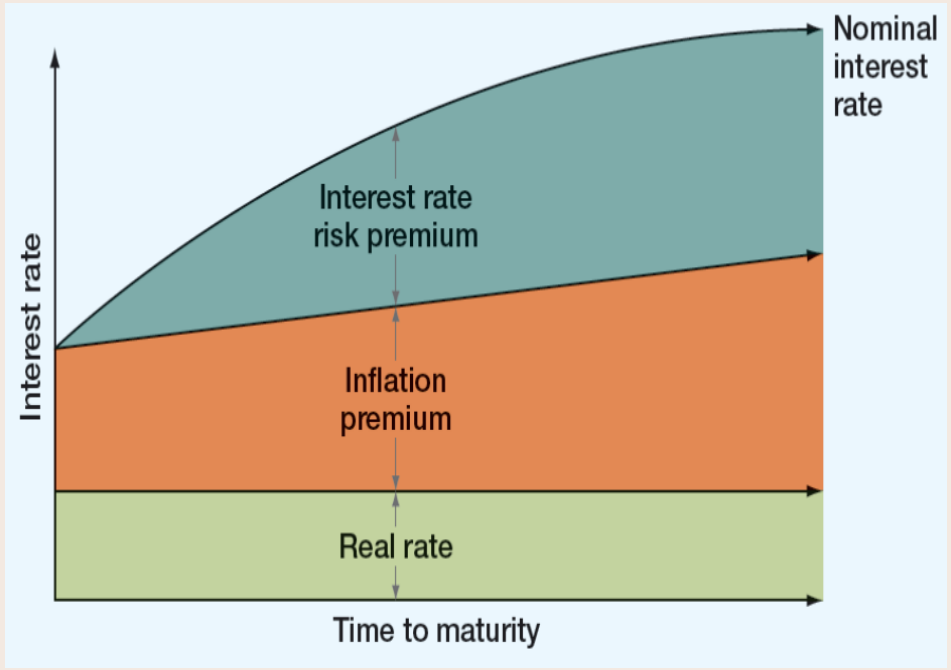
Components of The Term Structure

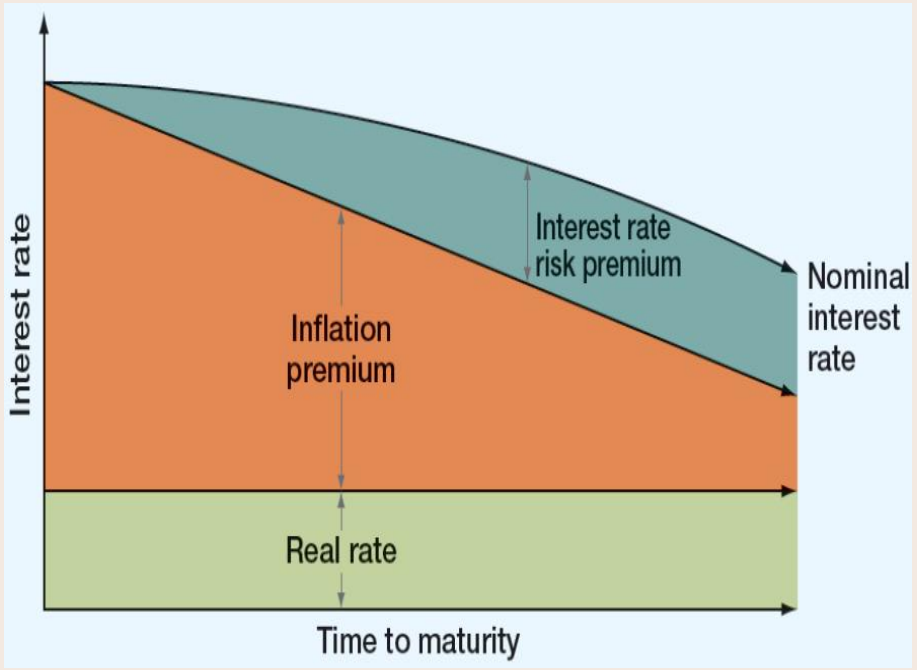
There are three components of the term structure:

1. **Real Rate of Interest**- what investors require for forgoing the use of their money.
2. **Inflation Premium**- compensation for the loss of purchasing power.
3. **Interest Rate Risk Premium**- compensation for holding long-term bonds and bearing the risk of loss resulting from a change in interest rates.

The term structure can be upward or downward sloping (perhaps due to beliefs that inflation is falling).

Components of The Term Structure





To Summarize

Bonds are traded over the counter. Real Rates consider *purchasing power* whereas Nominal Rates consider the growth in *dollars*. The term structure of interest rates is comprised of the real rate of interest, the inflation premium, and the interest rate risk premium.

Takeaways

Takeaways

1. Bonds are debt instruments issued to raise money for projects.
2. The value of a bond is found by finding the present value of the coupons and adding it to the present value of the lump sum payment at the end.
3. The Yield to Maturity is the rate required in the market on a bond.
4. The indenture includes many bond terms, including who is paid first and restrictions on borrowing.
5. Real rates are found by removing the affects of inflation from the interest rate.

End.